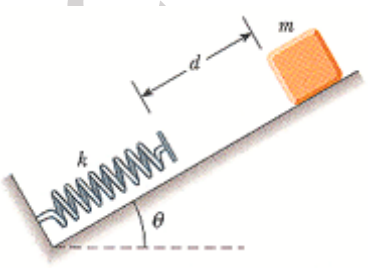
Q- An object of mass m starts from rest and slides a distance d down a frictionless incline of angle θ. While sliding, it contacts an unstressed spring of negligible massand force constant k. The object slides an additional distance x as it is brought momentarily to rest by compression of the spring. Find the initial separation d between object and spring.

Answer:

As the incline is frictionless, the total energy (potential and kinetic) of the system is conserved. In this system we have to consider

1. Gravitational P.E. = mgh
2. Elastic P.E. = (1/2) k x^2
3. Kinetic energy = (1/2) mv^2



Considering initial position of the mass and the final position when the mass is momentary comes to rest, the distance traveled by the mass is (d + x) and the loss in height is given by h = (d + x) sinθ

Referring the final position for zero gravitational potential energy,

total initial energy = mgh + 0 + 0 = mg (d + x) sin θ .

total final energy = 0 + (1/2) k x^2 + 0.

Applying law of conservation of energy

mg (d + x) sin θ = (1/2) k x^2

or $d = \frac{kx^2}{2mg\sin\theta} - x$